CLAIMS

1. A completion suspension valve system comprising:

a suspension valve housing, said valve housing having a production bore;

a valve element disposed in said suspension valve housing;

said valve being remotely actuatable between an open position and a closed position.

2. A system as claimed in claim 1 wherein the production bore is offset from the centre of the valve housing.

3. A system as claimed in claim 1 or 2 wherein the valve element is an apertured ball valve element with a valve bore offset from the centre of the ball, so that one portion of the ball element is relatively thick and another portion of the valve element is relatively thin.

4. A system as claimed in claim 1 or 2 wherein the valve element is a flapper valve.

5. A system as claimed in claim 3 wherein the offset bore valve seat is disposed in said product bore for engaging with said ball element, one side of the valve seat having a relatively thick portion and the other side of the valve seat having a relatively thin portion.

6. A system as claimed in claim 5 wherein an inclined groove is disposed in said production bore for receiving an elastomeric seal with the lowest part of the groove being disposed adjacent to the thinnest part of the valve seat to minimise the length of seat exposed to differential pressure.

7. A system as claimed in any preceding claim including actuation means coupled to the ball element for permitting remote actuation of the ball element.

8. A system as claimed in claim 8 wherein the actuation means comprising at least two moveable guide shafts disposed substantially parallel to the production bore, at least two actuation bars coupled between the respective guide shafts and to the apertured ball element, the actuation bars being coupled to the guide shafts by rotatable pin joints, and being slidingly located in respective bar pockets of said ball element.

9. A system as claimed in any preceding claim wherein said valve element may be actuated to remain in an open position, said system including ram means for moving between a first non-engaged position wherein said valve element remains normally open and a second engaged position where the valve is set in the open position.

10. A system as claimed in claim 9 wherein said ram means has locking mandrel means for engaging with a locking nipple and said mandrel means being actuatable by the ram means to move the locking nipple from a first unlocked position to a second locked position, such that when the nipple is in said second locked position the ball element is locked in the open position.

11. A system as claimed in claim 10 wherein the nipple is normally retained to the housing by means of a shear pin.

12. A system as claimed in claim 11 wherein the nipple has two legs, one leg being coupled to each of said guide shafts so that as said mandrel and ram move to engage and move the nipple towards said ball element, the nipple movement causes the guide shafts to rotate and move the ball element to a fully open position.

13. A system as claimed in any one of claims 3, 5 to 12 wherein said ball is allowed to float upwards when in said closed position to maintain a contact force between the valve seat and ball surface in proportion to the prevailing differential pressure, by providing trunnions with two arcuated portions and a rebate in each trunnion bore bearing for receiving said arcuate portion when the ball is in the closed position.

14. A method of remotely suspending and desuspending a well comprising the steps of:

providing a dual bore tubing hanger having a production bore and an annulus bore,

disposing a remotely operable valve in said production bore, and

actuating the valve remotely between an open and a closed position.

15. A method as claimed in claim 14 including the step of actuating the valve to a fully locked open position.

16. A method as claimed in claim 14 or 15 wherein said valve is actuated by translating linear movement to rotational movement.

17. A method as claimed in claim 16 wherein the transitional movement is achieved by providing actuating bars coupled between the rotatable ball element and rectilinearly moveable guide shafts, the actuating bars being rotatably coupled to the guide shafts by pin joints and being slideably moveable in pockets of the ball element.

18. A method as claimed in claim 15 wherein the method includes the step of engaging a locking nipple with a hydraulic operated mandrel and moving the nipple from a first unlocked position by severing a shear pin to a

second locked position by engaging the nipple with a resiliently biased locking pin.

19. A ball element for use in a completion suspension valve said ball element having a throughbore and a pair of trunnions to permit the ball to be rotated in a production bore between an open and a closed position, said throughbore being offset from the centre of the ball to create a relatively thicker portion and a relatively thinner portion on opposite sides of the throughbore, and one or more pockets disposed on either side of said throughbore adjacent said trunnions for receiving slideable bars for rotating said ball element on said trunnions.

20. A ball element as claimed in claim 19 wherein there are two pockets; one on each side of the ball.

21. A ball valve seat for use with the ball element as claimed in claims 19 or 20 wherein said seat has a throughbore offset from the centre of the seat to engage with the throughbore of said ball element when in said open position, said valve seat having a relatively thicker portion and a relatively thinner portion on opposite sides of said valve seat throughbore, said thinner portion being longer than said thicker portion

and being arranged to about said relatively thin portion of said ball valve element when in said closed position.

22. A ball valve seat as claimed in claim 21 wherein an inclined groove is disposed at the bottom of said valve seat, said inclined groove being adapted to receive an elastomeric seal for sealingly engaging with said ball element, the lowermost part of said groove being adjacent said relatively thin ball element portion and said valve seat portion.

23. A ball valve actuating mechanism for moving an apertured ball valve between an open and a closed position, said mechanism having a pair of rectilinear moveable actuated rods, each rod being coupled by a rotatable pin joint to an actuation bar and each actuation bar being slideably received in a pocket in said apertured ball value, the pin joints being constrained to moved rectilinearly with said guide shafts and actuation bars move relative to the ball as it rotates between a closed and open position.

24. A method of opening a closed ball valve and retaining the ball valve in an open position, said method comprising the steps of,

running a hydraulic piston with a mandrel at its leading end into a completion suspension valve housing;

engaging the mandrel with an override nipple;

forcing the override nipple to a locked position and simultaneously opening the valve,

retaining the nipple locked to the valve housing which also locks the valve in the open position.

25. A completion system valve override system comprising,

a xmas tree for coupling to a wellhead;

a lower riser safety package coupled to said xmas tree;

a hydraulic piston and mandrel override tool, coupled to said riser safety package;

said piston being a sufficient length to pass through said safety package, xmas tree, tubing hanger and enter said completion suspension valve housing for engaging with a valve override mechanism, said mechanism being hydraulically actuatable to move the valve to an open position and lock the valve in the open position.

26. A tubing hanger having an offset aperture ball valve for use with an in-line tree.

27. A subsea installation tree incorporating a suspension valve as claimed in any one of claim 1 to 20.

28. A tubing hanger for use with a hybrid tree insert, said tubing hanger having a completion suspension valve as claimed in any preceding claim.

29. A system as claimed in any one of claims 1 to 7 wherein the actuation means comprises at least one moveable guide shaft disposed in a bore parallel to the production bore, at least two actuation bars coupled between the respective guide shaft and the apertured ball element, the actuation bars being coupled to the guide shafts by rotatable pin joints, and being slideably located in respective bar pockets of said ball element.

30. A system as claimed in claim 29 wherein said moveable guide shaft is coupled to a yoke having two ends and the ends of the yoke are each coupled to two actuation bars disposed in parallel on each side of the ball element above and below the centre of the ball element rotation.

31. A system as claimed in any one of claims 7, 29 or 30 wherein said valve element is actuated to remain in the open position, said system including an override plug dimensionable to pass through an annulus bore and for engaging with the top of said actuation means, said override plug being responsive to pressure to force said actuation means downward to a lowermost position in an

actuation bore whereby in said lowermost position the ball valve element is actuated to a fully open position, said plug having locking means for engaging with said annulus bore when in said fully open position so that the annulus bore and the production bore are open.

32. A system as claimed in claim 31 wherein said override plug has an upper tubular housing, a lower plug pin coupled to the upper tubular housing by a shear pin, spring-loaded arms for locking the plug to the annulus bore when said production ball valve element is in the fully open position, and a retaining ring for retaining the spring-loaded arms when in an unlocked position, said retaining ring being releaseable by said lower plug pin when said override plus is in the locking position.

33. A method as claimed in any one of claims 14 to 17 wherein the method includes the steps of engaging an override plug with the top of a guide shaft,

moving the guide shaft and plug together with the guide shaft bore to a position where the valve is fully open, and locking the override plug in the shaft bore to maintain the ball element in the open position and the production bore and annulus bores open.

34. A ball valve actuating mechanism for moving an apertured ball valve between an open and a closed

position, said mechanism having a single rectilinear moveable actuation rod, said rod being coupled to a yoke having two free ends to which are coupled by a rotatable pin joint at least one actuation bar, said at least one actuation bar being slideably received in a pocket in said apertured ball valve, the pin joints being constrained to move rectilinearly within said guide shaft and the ball moves relative to the actuation bars as it rotates between an open and a closed position.

35. A method of opening a closed ball valve and retaining the ball open in an open position, said method comprising the steps of,

passing a sealing override plug through an annulus bore to engage with the top of a ball element actuation rod,

pressuring the annulus bore to force the override plug and the actuation rod to a position where the ball element is in a fully open position, and further actuating the override plug to lock the plug to the annulus bore to retain the ball element in a locked fully open position.

36. A system as claimed in claim 1 or 2 wherein the valve element is an apertured ball valve element with a valve bore offset from the centre of the ball, so that

one portion of the ball element is relatively thick and the bore cuts through the sphere of the ball such that the sphere wall is discontinuous.

37. A ball valve seat seal as claimed in claim 19 or 20 wherein said seat seal has a throughbore offset from the centre of the seal to engage with the throughbore of said ball element when in said open position, said valve seat having a relatively thicker portion and a relatively thinner portion on opposite sides of said valve seat throughbore, the length of the said thicker and thinner portions being dependent on the position of the hemisphere.

38. A completion valve system comprising:

a valve housing, said valve housing having a production bore and an annulus bore;

a production bore valve ement disposed in said valve housing and an annulus bore valve element disposed in said suspension valve housing;

said valves being remotely actuatable in said housing between an open position and a closed position.

39. A system as claimed in claim 38 wherein the valve system is a suspension system.

40. A completion valve system comprising:

a valve housing, said valve housing having a production bore and an annulus bore;

a production bore valve element disposed in said production bore and an annulus bore valve element disposed in said annulus bore,

single actuator means moveable within said housing for actuating the production valve element and the annulus valve element to move between a close and an open position,

and said actuator means being remotely operable to move said valves between said open and closed positions.

41. A system as claim in claimed 40 wherein said valve system is a suspension valve system.

42. A completion suspension valve system comprising:

a suspension valve housing, said housing having a valve bore;

a flapper valve element disposed in said housing and being moveable between a first position where the bore is clear and a second position where said bore is occluded;

upper piston means having a throughbore and being moveable between a lower position and an upper position, said upper piston means maintaining the flapper valve in said first position when in said lower position and

permitting the flapper valve to move to said second position when in said upper position;

lower piston means having a throughbore and being moveable between a lower position and an upper position for engaging with said flapper valve when said flapper valve is in said second position occluding said valve bore, the arrangement being such that

when said first piston is moved to said upper position said flapper valve element is urged to occlude said bore and said lower piston is moved to said upper position to engage an underside of said flapper valve whereby said flapper valve element is capable of containing differential pressure from below and above said valve element.

43. A valve system as claimed in claim 42 wherein the flapper valve element is mounted on a pivot to an element carrier, and resilient biasing means are coupled between the element and the carrier to bias the flapper valve element to a position to occlude the bore when the upper piston is in said upper position.

44. A valve system as claimed in claims 42 or 43 wherein a recess is defined in said housing for receiving said flapper valve element when said upper piston is in said lower position.

45. A valve system as claimed in any one of claims 42, 43 or 44 wherein said flapper valve element is carried by an annular ring which is secured to said valve housing, said upper piston passing through said valve ring and being sealingly engaged with said valve ring.

46. A method of remotely suspending and desuspending a well comprising the steps of:

disposing a remotely operable completion suspension valve system with a flapper valve element as claimed in claim 42 in a production bore,

and actuating the valve assembly between an open and a closed position,

and energising said flapper valve element in said closed position so that when said element is energised the flapper valve element is capable of containing differential pressure from below and above said valve element.

47. A completion suspension valve system comprising a valve housing having a throughbore and a flapper valve element disposed within said valve housing between a first position wherein said throughbore is open and a second position wherein said throughbore is closed and locking means for locking said flapper valve element in said closed position whereby said flapper element is

capable of containing differential pressure from below and above said flapper valve element.